COLORADO WATER CONSERVATION BOARD

Alamosa River Watershed Restoration Master Plan

Draft Executive Summary

March 2005

MWH

in association with

Agro Engineering
Lidstone & Associates
SWCA

Summitville Natural Resource Damage Trustees
Colorado Department of Public Health and Environment
Colorado Attorney General
Colorado Department of Natural Resources
U.S. Bureau of Land Management
U.S. Fish and Wildlife Service
U.S. Forest Service

Executive **SUMMARY**

ES.1 Introduction

The Alamosa River Watershed Restoration Master Plan (Master Plan) summarizes current environmental conditions and develops solutions for identified problems in the Alamosa River basin that will lead to a healthier watershed. The incentive for the Master Plan was provided by a legal settlement over potential injuries caused by the Summitville Mine. That settlement also provided funding for implementation of some of the restoration projects described in the Master Plan. The scope of the Master Plan includes the entire watershed, with the exception of the Summitville Mine Site itself, which is addressed through the Superfund Program. The Master Plan covers a broad array of natural resources and watershed functions and values. The result is a multi-disciplinary approach to watershed assessment that has produced a prioritized plan for watershed restoration and enhancement. Specific projects are identified, along with potential financing sources, including the Natural Resource Damage (NRD) funds from the Summitville legal settlement.

The State of Colorado and the United States recovered $5,000,000 in NRD funds to use to restore, replace, or acquire the equivalent of the natural resources potentially injured by the hazardous substances released from the Summitville Mine. There are three federal natural resource trustees and three State natural resource trustees (Trustees) who guided the Master Plan process and will also guide implementation:

- United States Department of the Interior's Fish and Wildlife Service
- United States Department of the Interior's Bureau of Land Management
- United States Department of Agriculture's Forest Service
- Colorado Attorney General
- Executive Director of the Colorado Department of Public Health and the Environment
- Director of the Colorado Department of Natural Resources.

The Alamosa River Foundation, a non-profit organization of local citizens, represented local interests and was heavily involved in development of the Master Plan.

The Master Plan was developed by MWH Americas, Inc., in association with Agro Engineering, Lidstone & Associates and SWCA, under contract to the Colorado Water Conservation Board.

ES.2 Affected Environment

The Alamosa River watershed comprises 148 square miles in the San Luis Valley of south-central Colorado. The mainstem of the Alamosa River is 51 miles long, extending from near the Continental Divide to east of the City of La Jara. Elevations vary from over 13,000 feet to about 7,600 feet. Key features in the watershed include:

- Summitville Mine, a gold mine that operated from 1986 to 1992 using open pit and cyanide leach methods but which is now a Superfund site;
- Terrace Reservoir, a storage impoundment for irrigation water;
- Extensive irrigated agriculture in the lower watershed;
- Extensive forested areas and hydrothermally altered zones in the upper watershed.

Figure ES-1 is an overview map of the watershed.

The Alamosa River watershed has been significantly impacted by human activity. In addition, several natural conditions also affect watershed resources. This report describes the affected environment of the Alamosa River Watershed according to resource categories. The key issues identified per resource category are described below.

Channel of the Alamosa River and major tributaries

- The upper watershed produces naturally high sediment loads.
- Terrace Reservoir, irrigation diversions, and channel straightening impact the river's geomorphology
- Structures located within Alamosa River floodplain are a flood hazard, especially in Capulin

Surface water quantity

- Highly altered hydrologic regime does not support natural functions and values.
- Historical streamflow has been significantly altered by water use for agriculture and other purposes,

particularly by operation of Terrace Reservoir. The river is dry downstream of Terrace Reservoir during late fall, winter, and early spring (see **Figure ES-2**).

- The Alamosa River is a highly over-appropriated stream.
- There are no unappropriated surface flows for environmental purposes.
- There may be limitations on future new storage, due to the Rio Grande Compact (**see Figure ES-3**) shows the Rio Grande River Basin in Colorado.

Surface water quality

- Hydrothermally altered areas naturally create water quality conditions with low pH and high metal concentrations in some areas of the Alamosa River watershed (see **Figure ES-4**).
- Historic mining created additional sources of contamination.
- Water quality in the Alamosa River downstream of Wightman Fork has improved significantly in recent years due to remediation efforts at Summitville. However, water quality below Wightman Fork continues to exceed pH, copper, zinc, and aluminum water quality standards. Iron concentrations are also high in comparison to toxicological reference values.
- The risk of untreated releases from the Summitville site remains high due to lack of storage and treatment plant capacity. Untreated releases have the potential to kill fish populations restored to the Alamosa River and impact downstream water users.
- The water of the Alamosa River is often observed to be turbid. Levels of suspended sediments rise exponentially during spring snow melt and precipitation events.

Groundwater

- Agricultural land use, irrigation, and drought have caused groundwater levels to decline.
- Naturally high metal content and mining activity in the upper watershed may have negatively impacted groundwater quality.
- Due to the limited amount of existing water quality data regarding groundwater basins affected by the Alamosa River, additional monitoring is necessary to accurately assess existing groundwater conditions.

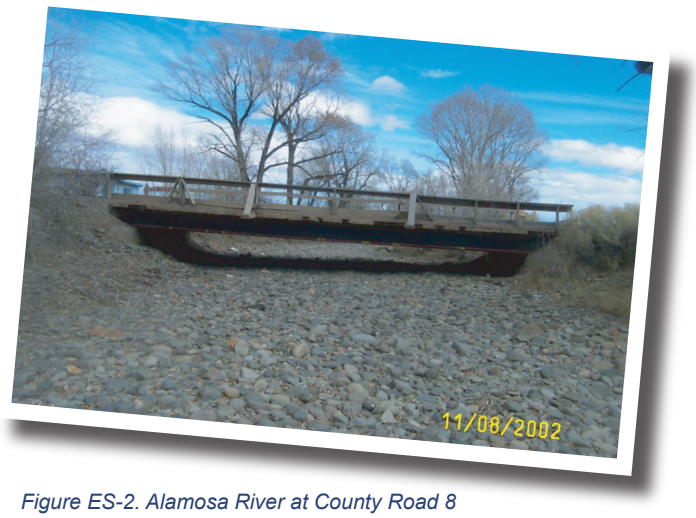


Figure ES-2. Alamosa River at County Road 8
Photo courtesy of Alan Miller

Terrace Reservoir

- The spillway is insufficient to pass the Probable Maximum Flood design inflow. The State Engineer has imposed a filling restriction that limits the water level in the reservoir.
- The dam was never constructed to the originally planned height. The dam could be raised, but a stability and liquefaction analysis would be required to assure the safety of the structure.
- The outlet structure has been a chronic source of problems and has required dewatering of the reservoir and subsequent flushing of sediment downstream.
- When the reservoir is emptied in the future, there must be a more effective method of preventing large quantities of sediment from being washed downstream.
- Deposition of metals and sediments in the reservoir has tended to improve downstream water quality. However, hypolimnetic water with the lowest pH and highest metal loads is often passed downstream to irrigators because the reservoir outlet is at the bottom.
- Resuspension of bottom sediments appears to lower pH and increase metals concentrations.

Sediments

- There is naturally high sediment load from upper watershed.
- Terrace Reservoir captures upper watershed sediment.
- Irrigation diversions reduce the sediment transport capacity of the river.
- Channel straightening has changed the river's sediment transport capacity.
- Sediment quality studies indicate elevated levels of total metals within the watershed.

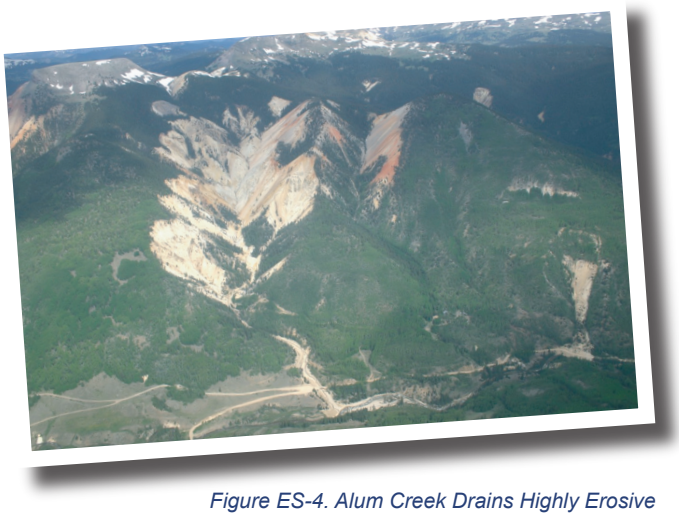


Figure ES-4. Alum Creek Drains Highly Erosive Terrain with Low pH Runoff

Riparian habitat (vegetative communities)

- Noxious and non-native vegetation have become established in the lower Alamosa River.
- Overgrazing of the riparian corridor has degraded habitat in the lower Alamosa River.
- Placer mining has impacted the riparian corridor of the upper Alamosa River.
- Reduced groundwater levels, low flows, water quality, and sedimentation in the Alamosa River impact the quality of riparian vegetation.

Biological resources (wildlife resources)

- Impaired water quality in the Alamosa River adversely effects biological communities.
- Fish populations cannot be maintained in the lower Alamosa River due to lack of flow.
- Lack of oxbows and floodplain in the Alamosa River limit habitat values.
- Cottonwood health has been degraded by low groundwater levels and lack of overbank flows in the lower watershed.
- Introduced fish species, such as carp, displace native fishes.

Agricultural uses

- High rates of channel erosion and deposition impact headgates and water diversion.
- Operation of Terrace Reservoir and senior ditches creates a dry channel for much of the year.
- A dry channel impacts the stability of diversion structures and the delivery of water due to lowered local groundwater levels and reduced riparian vegetation.
- Release of sediments during the draining of Terrace Reservoir impacts diversions and agricultural lands and places a burden on downstream water users.
- Degraded water quality impacted irrigation infrastructure, agricultural soils, crops, and livestock.

Recreational uses

- Impaired fisheries limit recreational use of the Alamosa River and tributaries.
- Sedimentation in Terrace Reservoir may limit fishery productivity and recreational opportunities.
- Public perception of the Alamosa River Watershed health deters recreational utilization.

The watershed was broken into 17 segments and subwatersheds for the affected environment analysis. **Figure ES-5** shows the segments and subwatersheds in the Alamosa River Watershed that are most impacted by human activities. **Table ES-1** shows the segment and subwatershed ratings that were assigned for each resource category according to the affected environment analysis.

ES.3 Master Plan Objectives and Watershed Vision

The Master Plan uses a multi-objective approach to make recommendations for watershed improvements. General Master Plan objectives as identified by local, state and federal stakeholders prior to the development of the Master Plan are:

- River and watershed health
- Protection of resources
- Restoration of impacted natural resources
- Bio-diversity
- Resource services to the public

The overall restoration strategy is to identify and pursue the opportunities for recovering lost natural values and enhancing those existing features that have the highest potential for success and that have the most favorable ratio of likely benefits to likely costs. Based on this strategy of balancing an idealistic view with pragmatic analysis, a "watershed restoration vision" was developed as a picture of what the watershed could look like after the Master Plan is implemented.

- We envision a naturally functioning channel system
- We envision a balance between competing human and environmental uses of water
- We envision water quality that supports beneficial uses in the watershed
- We envision Terrace Reservoir utilized reliably to its fullest capacity
- We envision a sustainable fishery on the Alamosa River and quality terrestrial and avian habitat

Table ES-1. Stream Segment and Subwatershed Rating

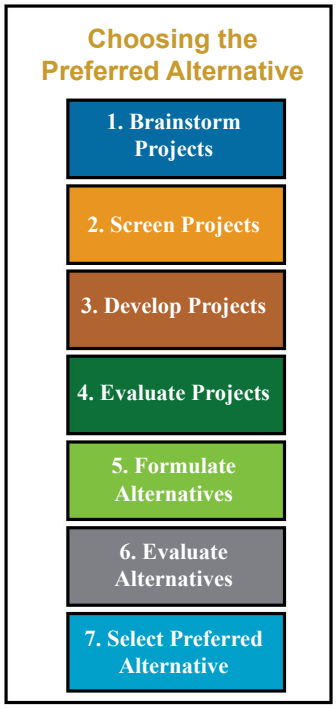
Category - Criterion	Stream Segment/Subwatershed														
	1	2	3	4	5	6	7	8	9	10	11	12	T1	W1-3	W4
Channels – Channel Stability	Poor	Poor	Poor	Fair	N/A	Fair	Good	Good	Good	Good	Good	Good	Good	Good	Good
Channels – Channel Capacity	Poor	Poor	Fair	Good	N/A	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good
Surface Water Quantity – Natural Flow Regime	Poor	Poor	Poor	Poor	N/A	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good
Surface Water Quality – Beneficial Uses	Fair	Fair	Fair	Fair	Fair	Poor	Poor	Poor	Poor	Poor	Fair	Fair	Good	Poor	Good
Surface Water Quality – Watershed Runoff Quality	Fair	Fair	Fair	Good	N/A	Good	Good	Good	Good	Good	Poor	Poor	Good	Poor	Fair
Ground Water – Beneficial Uses	Fair	Fair	Fair	Fair	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Terrace Reservoir – Design and Operation	N/A	N/A	N/A	N/A	Poor	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Sediments – Channel Sediment Balance	Poor	Fair	Fair	Poor	N/A	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good
Sediments – Watershed Sediment Production	Good	Good	Good	Good	N/A	Good	Good	Good	Good	Fair	Poor	Poor	Fair	Fair	Fair
Riparian Habitat – Health and Diversity	Poor	Poor	Poor	Fair	N/A	Poor	Poor	Poor	Poor	Poor	Fair	Fair	Good	Poor	Good
Biological Resources – Health and Diversity	Poor	Poor	Poor	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Good	Good	Good	Poor	Good
Agricultural Resources – Agricultural Benefits	Poor	Poor	Poor	Good	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Recreational Uses- Recreational Values	Poor	Poor	Poor	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Good	Good	Poor	Good
N/A = Not Applicable	Co Rd 10 to Point of last diversion	Gunbarrel Rd to Co Rd 10	Terrace Main Canal to Gunbarrel	Terrace to Main Canal to Terrace Outlet	Terrace Reservoir	French Creek to Terrace Reservoir Inlet	Beaver Creek to French Creek	Fern Creek to Beaver Creek	Jasper Creek to Fern Creek	Wightman Fork to Jasper Creek	Iron Creek to Wightman Fork	Treasure Creek to Iron Creek	Treasure Creek	Wightman Fork below Summitville	Wightman Fork above Summitville

- We envision restoration of riparian habitat in the watershed
- We envision an efficient use of agricultural water from the Alamosa River
- We envision recreational opportunities in the watershed that benefit the public

ES.4 Master Plan Process

The watershed restoration strategy is to implement the best combination of projects to obtain the watershed restoration vision described above. The best combination of projects is referred to as the preferred alternative. The following process was used to choose the preferred alternative:

- **Brainstorming -** Assemble a broad list of individual projects including all ideas submitted by the project team and local and agency stakeholders. All potential projects are included ignoring constraints.
- **Screening -** Eliminate projects with fatal flaws in the areas of technical feasibility, permitting, cost, legal issues, and public acceptance.
- **Project Development -** Further develop project details for the projects that passed the screening process.
- **Project Evaluation -** Evaluate projects according to their performance in several multi-disciplinary criteria. Each project is given a score and the best projects are identified.
- **Alternatives -** Assemble the best projects into watershed-wide alternatives that are different combinations of individual projects, each geared toward obtaining the watershed vision.



- **Alternative Impact Evaluation -** Evaluate both positive and negative impacts of the alternatives.
- **Choose Preferred Alternative -** Choose a preferred alternative based on impact evaluation and public comment.

The public has been involved in the Master Plan process since the beginning. Public meetings were held in the San Luis Valley to kickoff the project, discuss potential restoration projects, and formulate alternatives. The Alamosa River Foundation helped to locally publicize events and gather public input outside of meetings. Newsletters were produced and distributed to the entire Summitville interested parties mailing list to provide project status and solicit comment.

ES.5 Project Evaluation

The project team developed 73 potential structural and non-structural projects to improve the Alamosa River watershed. A fatal-flaw screening evaluation was used to eliminate 23 projects. The remaining 50 projects were further analyzed and prioritized. A project ranking and scoring methodology using 14 criteria was developed with both Trustee and stakeholder input. Each project was given a score between 1 and 5 for each criterion. The criteria were assigned different weights according to importance as determined by the stakeholders and Trustees. Each project was given a total score that is the sum of all of the weighted criteria scores (see **Table ES-2**). Actual scores for each criterion were suggested by the consultant team and then circulated to the public and Trustees for review and comment. The Board of the Alamosa River Foundation determined the scores in the three public categories: public acceptance, addresses issues critical to the public, and public benefits.

ES.6 Alternatives Development

An alternative is a comprehensive package of projects that addresses multiple watershed issues. Three alternatives were developed using different approaches. These alternatives are described below and shown in **Table ES-3**. The three watershed alternatives were each organized into three alternative funding levels: $5 million, $10 million, and $15 million. The first funding level is what is already available through the Summitville settlement. The other two funding levels are discussed because the Alamosa River Foundation and Trustees plan to seek additional funding sources to leverage the funds that are already available.

The table shows that the alternatives are similar in terms of content. The major difference is the order that projects are listed.

Preliminary Alternative 1 - Project Rank

The Project Rank Alternative is composed of the projects with the highest scores as shown in **Table ES-2**. The order of projects was slightly modified to include prerequisites and synergistic projects that would increase the effectiveness of the alternative.

Preliminary Alternative 2 - Watershed Objectives

The Watershed Objectives Alternative was assembled by the consultant team. This alternative is focused on the technical ability of projects to meet watershed objectives and the vision statements. At least one project was included to address each of the watershed problem categories identified at the outset of the restoration planning effort. This alternative is characterized by a large number of water quality projects because it is necessary to improve water quality in order to attain the vision statements.

Preliminary Alternative 3 - Trustee Preferences

The Trustee Preferences Alternative was developed by the Trustees based on their natural resource restoration goals for the Alamosa River watershed. Their alternative is similar to the other two alternatives. The Trustees included Project 32, acquisition of equivalent resource in the San Luis Valley for high quality habitat and recreation. This project would compensate for Summitville injuries to the Alamosa River through acquisition of equivalent resources in the neighboring Conejos River watershed for high quality habitat and recreation. This project was important to the federal Trustees as it would provide immediate benefits by protecting high-quality wildlife and recreation resources deemed important to the region.

ES.7 Preferred Restoration Alternative

The preferred alternative was determined in a stakeholder meeting held in La Jara on December 13, 2004. Stakeholders were presented with the three alternatives shown above. The benefits and constraints of some of the projects were discussed and projects were added to the preferred alternative with the consensus of the group. The preferred alternative is listed in **Table ES-4** for funding levels of $5 million, $10 million, and $15 million.

Table ES-2. List of Projects and Weighted Project Scores

		Likelihood of success if implemented	Technically feasible to implement	Protection of implemented project	Public Acceptance	Addresses Issues Critical to Public	Public Benefits	Public health and safety	Adverse impacts	Environmental Permitting / Water Rights	Benefits in multiple resource categories	Time to provide at least 50% of expected benefits	Duration of benefits	Benefit/Cost	Addresses Water Quality, Riparian and Aquatic Habitat Issues	Total	Rank	Potential for NRD Funding*	Estimated Project Life Cycle Cost (50 years)
Weight		2	1	1	3	3	3	1	1	1	2	1	1	1	2				
RIVER CHANNEL/CORRIDOR PROJECTS																			
1	Stream restoration Terrace Reservoir to Wightman Fork	4	5	4	3.4	3.4	3.4	3	4	3	4	4	4	4	3	84	4	x	$1.2M
2	Stream restoration Gomez Bridge to Gunbarrel Road	4	5	3	3.6	3.6	3.6	3	4	3	3	4	4	3	3	81	7	x	$800k
3	Funding to complete project between Gunbarrel Rd and County Rd 10	4	5	3	4.2	4.2	4	3	4	4	3	5	4	4	3	89	1	x	$120k
4	Stream restoration County Rd 10 to County Rd 13	3	3	3	4.2	3.8	4	3	4	3	3	4	2	2	3	78	10	x	$400k
5	Dead Tree Management Upstream of Terrace Reservoir	4	5	4	3	2.8	2.6	5	4	4	2	5	3	4	2	75	14	?	$50k
6	Dead Tree Management Downstream of Terrace Reservoir	4	5	3	3.6	2.4	2.6	5	4	4	2	5	3	4	2	75	15	?	$50k
7	Modify Land Use Regulations for Flood Control	2	5	5	1.8	2	2	4	5	5	1	5	5	5	1	64	32		$10k
8	Setback Levees at Capulin for Flood Control	3	4	4	1.4	1.4	1.6	5	2	2	1	4	5	3	1	52	42		$1M
WATER QUANTITY PROJECTS																			
9	Purchase appropriate water rights for instream flow	3	4	5	3.2	3.4	3.4	3	4	3	5	4	5	4	5	88	2	x	$1-4M
10	Controlled Releases from Terrace Reservoir with Supplemental Water Source	2	2	4	2.2	2.2	2.8	3	5	3	5	4	5	3	5	75	16	x	$200k
11	Aquifer storage for instream flow	2	2	4	2.2	2.2	2.4	3	3	3	5	3	5	2	5	69	23	x	$2M
12	Trade of direct flow diversion right for reservoir storage (no new water source)	4	4	4	2.6	2.6	2.8	3	4	3	5	4	5	5	5	84	3	x	$100k
13	New reservoir to store instream flow	5	4	5	2.2	1.8	2	3	1	1	5	2	5	1	5	70	22	x	$10M
14	New reservoir to store existing agriculture water rights	5	4	5	2.2	2	2.2	3	1	1	5	2	5	1	2	65	29		$10M
TERRACE RES PROJECTS																			
15	Increase spillway capacity	4	5	4	3.4	3.6	3.6	4	4	3	3	3	5	4	2	82	6	?	$1.5M
16	Raise crest of dam	4	3	4	2.6	2.6	2.8	4	4	3	3	3	5	3	2	71	20	?	$3M
17	Sediment removal to increase capacity	3	4	3	1.6	2.2	2.2	3	2	2	3	4	3	2	2	57	35	?	$2M
18	Improve outlet works (tower)	4	4	4	2.6	2.6	2.6	3	4	3	3	4	5	2	3	72	19	x	$3M
19	Power generation at Terrace Reservoir	2	4	3	2.2	1.8	2	3	3	2	1	3	5	3	1	52	43		$7M
SEDIMENT MANAGEMENT PROJECTS																			
20	Lower watershed sediment deposition locations	4	4	3	2.2	2.6	2.4	3	4	3	3	4	2	4	3	69	26		$200k
21	Road management in upper watershed	2	3	3	1.6	1.6	2	3	4	4	3	4	3	2	2	56	38	x	$50k
22	Sediment traps at tributary confluences	2	4	3	3.2	3.6	3.4	4	4	3	5	4	2	3	3	78	12	x	$2M
WATER QUALITY PROJECTS																			
23	Reclamation of abandoned mines	4	4	3	1.8	2.2	2.2	5	4	3	4	4	5	2	4	73	18	x	$325k -$1.5M
24	Mainstem lake or reservoir below Wightman Fork	3	4	5	2	2	2	5	2	1	4	2	5	3	5	69	24	x	$3-15M
25	Sulfate reducing wetland on Wightman Fork or other tributaries	3	3	4	1.6	2	2.2	5	2	3	4	3	3	3	4	65	28	x	$2M
26	Active water quality improvement on tributaries upstream of Wightman Fork	3	3	5	1.8	2	2	5	4	3	4	3	3	3	4	68	27	x	$1-4M
RIPARIAN HABITAT PROJECTS																			
27	Noxious weed management in the upper watershed	3	4	3	2.8	3.6	3.6	3	5	5	2	5	3	2	2	74	17	?	250k
28	Noxious weed management in the lower watershed	3	4	2	3.8	4	4	3	5	5	3	5	3	2	2	80	8	?	250k
29	Revegetation in the lower watershed	4	4	3	3	3	2.8	3	5	5	4	3	5	5	4	83	5	x	$300k
30	Grazing management	4	5	2	3.2	2.6	3	3	5	5	4	3	5	4	3	80	8	x	$200k
31	Riparian Buffer Zone	4	5	2	2.6	2.8	2.6	3	5	5	4	3	5	4	3	78	10	x	$200k
32	Acquisition of equivalent resource in San Luis Valley for high quality habitat and recreation	5	5	5	1.2	1	1	3	5	5	3	5	5	4	1	65	31	x	$800k
33	Purchase land DS of Wightman Fork for recreation and habitat	5	3	5	1.2	1.2	1.2	3	5	5	3	5	5	3	4	69	25	x	$1-3M
BIO RESOURCES PROJECTS																			
34	Fish-stocking above Terrace	2	5	3	1.8	1.4	1.4	3	4	5	2	4	2	4	1	54	41	x	$50k
35	Fish-stocking at Terrace	3	5	3	2.4	1.8	1.6	3	4	5	2	4	2	4	1	59	33	x	$50k
36	Fish-stocking below Terrace	2	5	3	2.2	2	2	3	4	5	2	4	2	2	1	57	36	x	$50k
37	Construction of fish barriers	4	5	3	1.4	1	1	3	4	3	1	4	4	3	3	55	40	x	$200k
38	Establishing conservation easements	5	4	5	1.8	1.6	1.6	3	5	5	4	4	5	4	4	76	13	x	up to $1k/ acre
AGRICULTURAL PROJECTS																			
39	Ditch headgate consolidation	3	4	2	2.2	2.4	2.4	3	4	3	3	4	5	3	2	65	30		$200k
40	Replace headgates with corrosion resistant materials	4	5	2	3	3.4	3.4	3	5	5	1	4	3	2	1	70	21		$300k
RECREATION PROJECTS																			
41	Improve public access to Terrace Reservoir	3	5	4	1.8	1.4	1.4	3	5	5	1	4	5	4	1	59	34	x	$100-200k
42	Improved access to main stem of the river above Terrace	4	4	4	1.4	1.4	1.4	3	4	5	1	4	5	3	1	57	37	x	$500k
43	Improved access to main stem of the river below Terrace	4	3	4	1.4	1.4	1.4	3	4	5	1	4	5	3	1	56	39	x	$500k
STUDIES AND ADMINISTRATIVE ACTIVITIES																			
44	Funding for citizen group to help implement and monitor the Master Plan	4	5					3	5					5	5	36	1	x	$300k
45	Site specific PMF study	3	5					3	5					4	1	25	4	?	$20k
46	Ice Jam Flooding Study	3	3					4	5					2	1	22	7	x	$25k
47	Capulin Flood Hazard Mitigation Plan	3	5					5	5					3	1	26	2		$50k
48	Dewatering Management Plan	3	3					3	5					4	2	25	4		$25k
49	Terrace Reservoir sediment quality study	3	4					4	5					3	2	26	2	?	$75k
50	Ground water monitoring	3	5					3	5					3	1	24	6		$150k

* X = qualifies for NRD funding, ? = may qualify for NRD funding, blank = unlikely to qualify for NRD funding
Note: the top 10 ranked projects are shown in bold purple

Table ES-3. Three Preliminary Alternatives

By Highest Project Score	$M	Watershed Objectives	$M	Trustee Preferences	$M
44. Funding for citizen group	0.3	44. Funding for citizen group	0.3	44. Funding for citizen group	0.3
3. Funding to complete project between Gunbarrel Rd and County Rd 10	0.12	9. Purchase appropriate water rights for instream flow	3.3	3. Funding to complete project between Gunbarrel Rd and County Rd 10	0.12
9. Purchase appropriate water rights for instream flow	4	12. Trade of direct flow diversion right for reservoir storage (no new water source)	0.1	32. Acquisition of equivalent resource in San Luis Valley for high quality habitat and recreation	0.8
12. Trade of direct flow diversion right for reservoir storage (no new water source)	0.1	2. Bank Stab Gomez to Gunbarrel / Reveg in lower wshed / dead tree mgmt / noxious weed control / grazing management	1.2	9. Purchase appropriate water rights for instream flow	2.5
1. Most important Stream restoration areas from Terrace to Wightman Fork	0.5	3. Funding to complete restoration project from Gunbarrel to Cty Rd 10	0.12	12. Trade of direct flow diversion right for reservoir storage (no new water source)	0.1
				1. Bank Stab Terrace to Wightman Fork / dead tree mgmt upper watershed	1.2
Subtotal	**5.02**	**Subtotal**	**5.02**	**Subtotal**	**5.02**
1. Complete Stream restoration Terrace to Wightman Fork / dead tree mgmt upper watershed	0.7	9. Finish purchasing water rights	0.7	9. Finish purchasing water rights	1.5
15. Increase spillway capacity (in return for instream flow storage) / PMF Study	1.52	22. Sediment trap pilot project with water quality on Alum Creek	1	2. Bank Stab Gomez to Gunbarrel / Reveg in lower wshed / dead tree mgmt / noxious weed control / grazing management	1.2
2. Bank Stab Gomez to Gunbarrel / Reveg in lower wshed / dead tree mgmt / noxious weed control / grazing management	1.2	23. Reclamation of abandoned mines (Pass me by mine only)	0.35	15. Increase spillway capacity (in return for instream flow storage) / PMF Study	1.52
4. Stream restoration County Rd 10 to County Rd 13	0.4	1. Bank Stab Terrace to Wightman Fork / dead tree mgmt upper watershed	1.2	38. Conservation / recreation / access easements in lower watershed (500 acres)	0.5
31. Riparian Buffer Zone	0.2	15. Increase spillway capacity (in return for instream flow storage) / PMF Study	1.52	31. Riparian Buffer Zone	0.2
22. Sediment trap project phase 1 (suggest Alum Creek)	1	41. Increased access to Terrace Res (include parking lot, public education, trail)	0.2		
		38. Recreation / access easements in upper watershed (2 locations, 100 acres total)	0.1		
Subtotal	**10.04**	**Subtotal**	**10.09**	**Subtotal**	**9.94**
22. Complete sediment trap project	1	38. Conservation / recreation / access easements in lower watershed (500 acres)	0.5	24. Mainstem lake for water quality (small)	4
38. Recreation / access easements in upper watershed (2 locations, 100 acres total)	0.1	24. Mainstem lake for water quality (small)	4	23. Reclamation of abandoned mines (Pass me by mine only)	0.35
38. Conservation / recreation / access easements in lower watershed (500 acres)	0.5	20. Lower watershed sediment deposition locations	0.2	41. Increased access to Terrace Res (include parking lot, public education, trail)	0.2
23. Reclamation of abandoned mines (Miser, Pass-me-By major projects, small projects at other sites)	1.5	35. Fish stocking at Terrace Reservoir	0.05	20. Lower watershed sediment deposition locations	0.2
18. Improve Terrace Reservoir outlet works (tower)	3	48. Terrace dewatering management plan / sediment quality study	0.1		
Total	**16.14**	**Total**	**14.9**	**Total**	**14.7**

Note: Projects that were split between funding levels are indicated by an arrow. Only projects that can be completed in increments were split. Projects that are the same amongst the alternatives are shown in the same color. The cost of combined projects, such as stream restoration with revegetation, was estimated as 80 percent of their combined individual totals due to economy of scale for doing them at the same time.

Table ES-4. Preferred Alternative

Project	Cost
44. Funding for Alamosa River Foundation to help implement and monitor Master Plan	$300,000
3. Funding to complete ongoing streambank project between Gunbarrel Road and County Road 10	$120,000
2. Stream restoration from Gomez Bridge to Gunbarrel Road; Revegetation, dead tree management, noxious weed management, and grazing management in lower watershed	$1,200,000
9. Purchase appropriate water rights for instream flow downstream of Terrace Reservoir	$3,300,000
12. Trade of direct flow diversion right for storage of instream flow water rights in Terrace Reservoir (no new water source)	$100,000
Subtotal	**$5,000,000**
9. Finish purchasing water rights	$700,000
1. Stream restoration from Wightman Fork to Terrace Reservoir; dead tree management in upper watershed	$1,200,000
15/45. Increase Terrace Reservoir spillway capacity to remove storage restriction (in return for instream flow storage); PMF Study	$1,520,000
31. Riparian buffer zone	$200,000
22. Sediment trap pilot project with water quality best management practices on Alum Creek	$1,000,000
23. Reclamation of abandoned mines (Pass-Me-By mine only)	$325,000
Subtotal	**$10,000,000**
38. Recreation or access easements in upper watershed (2 locations, approximately 100 acres total)	$100,000
38. Conservation / recreation / access easements in lower watershed (approximately 500 acres total)	$500,000
20/4. Lower watershed sediment deposition locations combined with stream restoration from County Road 10 to County Road 13	$300,000
24. Mainstem lake for water quality (small size option)	$4,000,000
41. Increased access to Terrace Reservoir (include parking lot, public education, trail)	$100,000
Total	**$15,000,000**

Note: Arrow indicates that Project 9 is split into two phases. The cost of combined projects, such as stream restoration with revegetation, was estimated as 80 percent of their combined individual totals due to economy of scale for doing them at the same time.

Figure ES-6 depicts the location of the projects included in the preferred alternative. Each project is described briefly below.

Project 44. Funding for Alamosa River Foundation to Help Implement and Monitor the Mater Plan

The Alamosa River Foundation was involved in the development of the Master Plan from its inception. It is recommended that the Alamosa River Foundation be provided with funding for a part-time staff person or persons to assist the Trustee Council by performing the following tasks:

- Act as watershed coordinator to facilitate community meetings.
- Assist in restoration project monitoring activities.
- Act as a restoration project sponsor/manager to submit proposals to the Trustee Council for NRD funding.
- Act as project manager to implement restoration projects listed in the Master Plan but not receiving NRD funding.
- Seek additional funding from other sources for restoration projects to increase the funding available for watershed restoration projects well beyond the NRD funding.
- Seek additional funds for operating the Alamosa River Foundation to increase the scope and scale of activities the Foundation is able to perform.
- Work with the Colorado Tourism Office and other agencies and non-profit groups to promote tourism and recreation in the Alamosa River watershed.
- Conduct a public relations campaign to publicize watershed improvement projects, increased recreational opportunities in the watershed, and success stories.
- Communicate potential work opportunities to local businesses by publicizing RFPs, contracting, and project management opportunities.
- Strive to manage and complete projects in the most cost-effective way in order to maximize the goals that can be achieved with available funding.

Project 9. Instream Flow Water Rights

This project would acquire water rights to maintain streamflow during periods when the river is dry under existing conditions. The minimum release from Terrace Reservoir needed to significantly improve water quantity conditions below Terrace Reservoir is not known for certain. It has been assumed that reasonable targets are a 10 cubic feet per second flow from Terrace Reservoir to Gunbarrel Road and a 5 cubic feet per second flow from Gunbarrel Road to County Road 10. A senior priority water right would be purchased from one or more willing sellers to provide sustained instream flows in virtually every year. A senior right could be combined with other lower priority rights until the target flow is established.

If willing water right sellers are identified, there are still several challenges to implementing this project including:

- Acquiring a water right to establish a more sustainable instream flow lasting longer than the current flow management will only be successful if storage is available for that flow (see Projects 12 and 15).
- Negotiations with the Colorado Water Conservation Board (CWCB) will be required to create an instream flow donation or lease agreement.
- Applications to change an agricultural water right to instream flow uses must be formulated by an attorney and filed with the water court.
- The water right may be obtained with or without the associated land. If land is acquired as part of the transfer, a plan for long term management of the property will have to be developed.

Project 12. Trade of Direct Flow Diversion Right for Terrace Reservoir Storage

Storage of the acquired water rights would be needed to capture spring and summer runoff for release throughout fall and winter. Assuming storage could fill over 6 months and release over 6 months, about 3,600 acre-feet of storage would be needed.

This project is an option for storing acquired water rights in Terrace Reservoir without construction of new storage facilities. Potentially, Terrace Irrigation Company could use the acquired water right as it is available in the spring and summer for irrigation purposes. The amount diverted would vary based on the water year. Then, an equal amount could be released from Terrace Reservoir during late fall, early spring, and perhaps winter months as a trade.

By spring, the release out of Terrace Reservoir would reduce the volume of stored water in Terrace Reservoir by the total amount diverted the previous season through the Terrace Main Canal. This additional space could then be used to capture high spring flows. Therefore, the storage available for Terrace Irrigation Company to capture high flows would not be reduced. However, the Terrace Irrigation Company would

Figure ES-7. Terrace Reservoir Spillway from Downstream

Figure ES-8. Ongoing Stream Restoration Project County Road 10 to Gunbarrel Road

probably be forced to divert more water early in the irrigation season while the acquired water right was in priority and reduce stored water that would be available late in the irrigation season.

This project would require Terrace Irrigation Company to agree to the trade, and reservoir improvements may be needed as an exchange for the trade. It would also require approval from the Division Engineer and potentially a water right change.

Project 15. Increase Terrace Reservoir Spillway Capacity

Terrace Reservoir is currently operating under a State Engineer imposed storage restriction due to inadequate spillway capacity (see **Figure ES-7**). Increasing the spillway capacity, thus allowing for the removal of the filling restriction, is the most economical way to increase the physical storage capacity available in Terrace Reservoir. Removing the filling restriction would recover about 2,200 acre-feet of storage capacity. This project could potentially be done in place of or in addition to Project 12, Trade of Direct Flow Diversion Right for Reservoir Storage.

Project 45. Probable Maximum Flood Study

Conducting a site-specific Probable Maximum Flood (PMF) study for the basin could potentially reduce the cost of increasing the spillway capacity. Site-specific PMF studies are frequently successful in reducing the anticipated amount of flow that spillway structures are required to pass. A more specifically calculated PMF could reduce the cost required to improve the spillway and remove part or all of the State Engineer's restriction on the reservoir. This project would be done in conjunction with Project 15, Increase Terrace Reservoir Spillway Capacity.

Stream Restoration and Vegetation Projects

The stream restoration projects will stabilize the channel and banks, thereby decreasing the amount of sediment entering the river, promoting native streambank vegetation, improving diversion structure performance, and enhancing fish and migratory bird habitat. The main focus of the proposed stabilization and restoration projects is to limit the amount of sediment entering the river due to stream bank erosion. Mitigating sediment supply will improve channel stability at irrigation diversions and bridges, and will help maintain channel capacity. The four channel stabilization projects included in the preferred alternative are:

- Project 1. Terrace Reservoir to Wightman Fork
- Project 2. Gunbarrel Road to Gomez Bridge
- Project 3. Funding to complete ongoing restoration project from County Road 10 to Gunbarrel Road (see **Figure ES-8**)
- Projects 4 & 20. County Road 13 to County Road 10

Three vegetation projects were combined with the stream restoration projects in order to increase the benefits and maintainability of the stream restoration.

- Project 5. Dead tree management in the Jasper area where trees fall in the stream and cause localized flooding
- Project 6. Dead tree management near Capulin where a 2-mile row of trees are dead and in danger of destabilizing the stream bank.

- Project 20. Revegetation
- Projects 27 & 28. Noxious weed management

Project 31. Riparian Buffer Zone

A riparian buffer is an area adjacent to a water body that has been set aside for conservation and maintenance to protect stream and riparian habitat quality. Activities such as farming and development are limited in the buffer zone. Buffers can be created through a combination of ordinances and easements, or can be implemented on a voluntary basis. **Figure ES-9** shows the implementation of a buffer zone with cattle fencing.

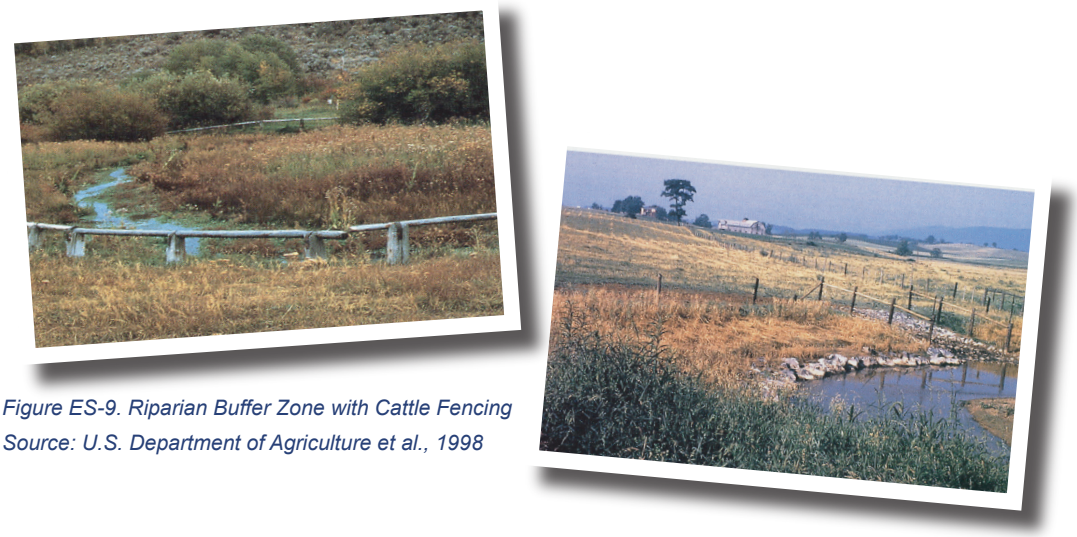


Figure ES-9. Riparian Buffer Zone with Cattle Fencing
Source: U.S. Department of Agriculture et al., 1998

Project 22. Sediment Trap Pilot Project with Water Quality BMPs on Alum Creek

During high flows, Alum Creek carries a tremendous bedload of sediments derived from hydrothermally altered rocks to the Alamosa River. These rocks typically contain sulfide-rich accessory minerals, which when oxidized contribute to metal loading as well as low pH in the Alamosa River. Following spring runoff, a large fan of materials is deposited at the terminus of the creek, and these sediments are then progressively eroded and carried downstream by the Alamosa River.

A sediment trap and water quality project would consist of regrading the fan area, stabilizing the adjacent river bank with limestone rock, constructing limestone rock check dams within the Alum Creek channel to trap a portion of the annual bedload, and directing the lower portion of Alum Creek to a flow-through pond. There are several options for water quality improvements that could be tested on Alum Creek as pilot projects and potentially implemented elsewhere if funds are available. However, any sediment trap and water quality project would require significant, regular maintenance.

Project 23. Reclamation of Pass-Me-By Mine

Contaminant loads from smaller historical mining sites are less significant on a watershed scale than loads from the Summitville site and loads from natural sources. These smaller mine sites represent less than one percent of the watershed contaminant load for copper, zinc, and magnesium, and less than 3 percent of the contaminant load for iron and aluminum. However, as point sources the mines are more readily treatable than non-point sources. The Pass-Me-By Mine produces the highest contaminant load of all of the smaller sites (see **Figure ES-10**). The reclamation project could include a combination of an anoxic limestone drain at the collapsed mine portal followed by a sulfate reducing wetland or settling basin as well as capping and diversion of drainage around the mine tailings dump. The Pass-Me-By Mine is located on private property and an agreement would be needed from the landowner to implement the project.

Project 38. Easements

Easements may be negotiated with willing landowners along the Alamosa River for various purposes such as conservation, recreation and access to the Alamosa River. Conservation easements are a tool to protect and enhance existing quality habitat and areas that can be improved through restoration projects such as those in

Figure ES-10. Photo of Pass-Me-By Mine Portal

the riparian corridor. Conservation easements are legal agreements between a landowner and a public agency or conservation group, in which the parties agree to protect certain natural resource values of the land or provide access to the public. Due to the extensive private ownership along the river, access and recreation easements are proposed to allow the public to benefit from the restoration projects.

Project 24. Mainstem Lake for Water Quality

A lake constructed on the mainstem of the Alamosa River below Wightman Fork could significantly improve water quality conditions downstream in the watershed. The primary water quality improvement mechanism of a lake is the capture of sediments. Suspended sediments and metals in particulate form would be removed from the Alamosa River by such a lake. Lime addition or injection within the lake is an additional active process that could potentially reduce all water quality contamination and help meet water quality standards. In order to maintain the lake's capacity, sediments would periodically need to be removed.

Project 41. Increased Access to Terrace Reservoir

Improving public access to Terrace Reservoir should increase recreational utilization of the reservoir area. Improvements can include increased parking on FR 250, the establishment of a maintained trail from the parking area to the reservoir shore, fishing access, small boat and picnicking facilities, and lavatories. Educational signage could be included to teach visitors about water quality, mining impacts, and the Master Plan.

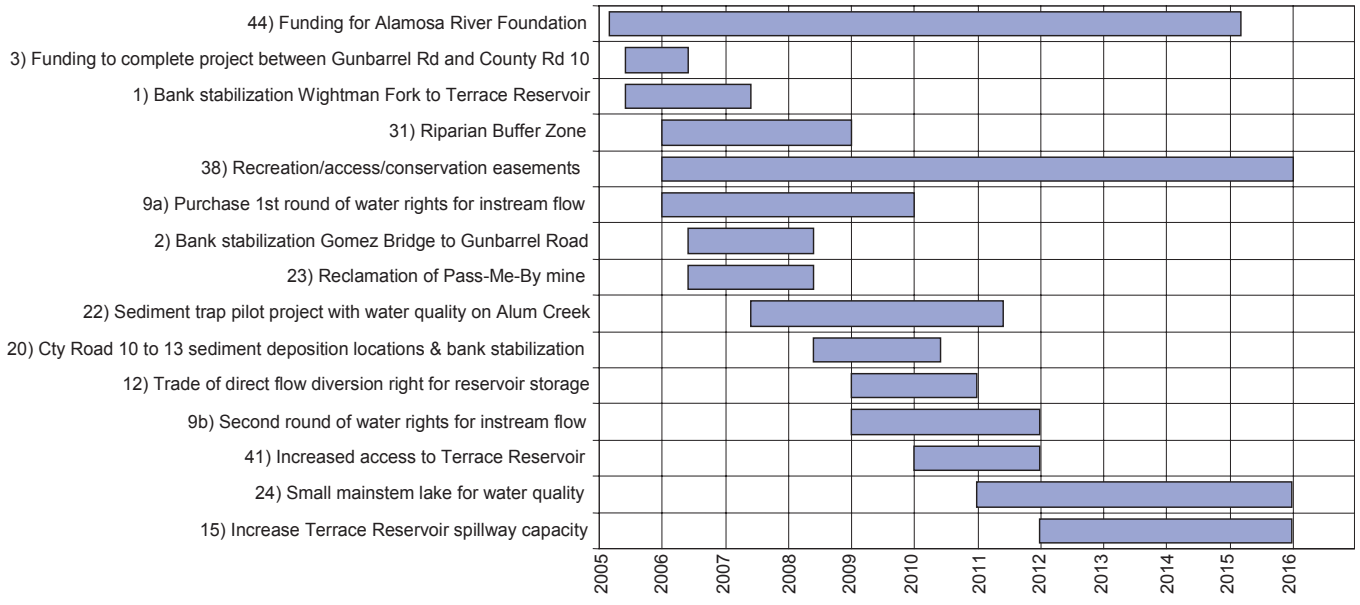
ES.8 Implementation

The idea of opportunistic implementation will be important to making the most of the Master Plan. Opportunistic implementation means that projects should be implemented according to the following conditions:

- As the specific project proposals are submitted to and approved by the Trustee Council and Alamosa River Foundation,
- As outside project proponents or "passionate advocates" are identified,
- As the appropriate mix of sufficient funding becomes available to complete a particular project, and
- As a specific project's implementation is required by or coincides with another related project that is being implemented.

Figure ES-11 shows one possible implementation schedule. As noted above, many factors will influence the actual order that projects are implemented. The Trustees and stakeholders will chose to implement projects in an order that is appropriate for available funding and based on other factors. The actual order may be different from that shown below.

Figure ES-11. Possible Implementation Schedule for Preferred Alternative



Note: this chart represents one possible sequence of projects. Actual project sequencing may be different.

Other sources of watershed restoration funding are available for those Master Plan projects that do not qualify for NRD funding and as matching funds for those that do. Potential national, state, and local funding sources are summarized below:

- U.S. Army Corps of Engineers (Restoration of Abandoned Mine Sites (RAMS))
- American Sportfishing Association (FishAmerica Foundation)
- U.S. Department of Agriculture and Natural Resources Conservation Service (Integrated Research, Education, and Extension Competitive Grants, Farm and Ranch Land Protection Program, Conservation Reserve Program, Environmental Quality Incentives Program, Resource Conservation and Development, Small Watershed Program, Wetlands Reserve Program, Wildlife Habitat Incentive Program, Grassland Reserve Program)
- U.S. Fish and Wildlife Service (Partners for Fish and Wildlife)
- Patagonia (Environmental Grants)
- U.S. EPA (Regional Geographic Initiative Program, Assessment and Watershed Protection Program Grants)
- Department of Homeland Security
- National Research Initiative (Enhancing the Prosperity of Small Farms and Rural Agricultural Communities Competitive Grants)
- National Fish and Wildlife Foundation (Pulling Together Initiative Grant Program)
- National Geographic Society (Conservation Trust Grants)
- River Network (Watershed Assistance Grants)
- U.S. Department of Interior Bureau of Land Management
- U.S. Department of Agriculture Forest Service
- Colorado Water Conservation Board (Construction Loan Program)
- Colorado Division of Wildlife (Cooperative Habitat Improvement Program, Habitat Partnership Program, Colorado Waterfowl Stamp Program, Colorado Wetland Initiative Legacy Project, Colorado State Trust Lands)
- Colorado Department of Public Health and Environment (Clean Water Act Section 319 Non-point Source Grants)
- Great Outdoors Colorado Trust Fund (GOCO)
- San Luis Valley Wetland Focus Area Committee
- Rio Grande Headwaters Land Trust

It is critical that the Alamosa River Foundation and other project sponsors leverage the $5 million NRD funding with matching funds in order to maximize benefits to the Alamosa River Watershed.

ES.9 Monitoring

Project monitoring to measure performance in meeting the desired objectives and providing the anticipated benefits is required for NRD-funded projects, and is recommended for all Master Plan projects. Monitoring plans should be developed and included in each specific project proposal. Monitoring activities will be different depending on the type of project. The Trustee Council and Foundation will monitor project results and make them available to the public.